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A Method for Collecting Soil-pupating *Rhyacionia* Pine Tip Moths

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Plastic foam cups filled with soil and placed beneath infested shoots are used to collect soil-pupating *Rhyacionia*. The pupation cups are inexpensive, easily installed, and easily removed for rearing pupae, pupal parasitoids, and adult moths.

Keywords: *Rhyacionia neomexicana*, pine tip moth collecting technique, insect rearing, parasitoids.

Introduction

Studies on *Rhyacionia* pine tip moths often require collection of cocoons. This is difficult in the case of soil-pupating species because the cocoons are small, fragile, and may be lost to predation before they are collected. For example, mice dig cocoons of the southwestern pine tip moth, *R. neomexicana* (Dyar), at the bases of infested seedlings and feed on both larvae and pupae (Jennings 1975).

The collection technique described here, which employs plastic foam cups, was developed and successfully used at Chevelon, Ariz., with *R. neomexicana* (Dyar) and *R. jenningsi* Powell. The technique should also work with other species having similar habits (i.e., pupating at the bases of infested trees attached to the bole). The cups are useful for collecting pupae, rearing pupal parasitoids, and rearing adult tip moths. Other uses include (1) determining when larvae descend tree boles (cups

are inspected hourly or daily and larvae removed before pupation), (2) determining the period or duration of larval descent, (3) investigating the processes of cocoon formation and pupation, and (4) measuring the effects of predation indirectly by exclusion.

Materials and Equipment

The materials and equipment needed to install the cups, collect the cocoons, and rear pupal parasitoids and adult tip moths include the following:

- Plastic foam cups, 6-8 ounce
- Wire, 24 gauge, light duty
- Calipers
- Knife or razor blade
- Wire cutters
- Hand pliers
- Trowel
- Waterproof ink marker
- Pencil or pen
- Insect forceps
- Hand pruners
- Masking tape
- Nylon screening, fine mesh
- Rubber bands

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Method

The collecting method consists of (1) locating infested shoots before the larvae leave the shoots, and (2) attaching plastic foam cups filled with soil beneath the shoots (fig. 1). Descending larvae bore into the cup soil and pupate against the tree bole (fig. 2). The larvae chew shot holes in the tree bark and mix exuding resins with silk to form cocoons. The cocoons are easily collected by disassembling the cup and removing the soil.

Installation

Cups are easily installed by following the procedures illustrated in figure 3 and described below:

1. Locate infested shoot (fig. 3A).
2. Remove needles below shoot and measure stem diameter with calipers (fig. 3B).
3. Mark cup bottom and cut out hole; slit bottom across diameter (fig. 3C).
4. Extend slit up one side of cup to rim (fig. 3D).
5. Open cup and place around stem (fig. 3E).
6. Wire shut and fill cup with soil (fig. 3F).



Figure 1.—Plastic foam cup below infested terminal shoot.

Locate infested shoots in the field prior to the time larvae leave the shoots and descend tree boles for pupation. For the southwestern pine tip moth in Arizona, pupation begins in early July and is generally completed by mid-August (Jennings 1975). Inspection of damaged shoots will indicate the presence or absence of larvae; fresh mammal diggings around root collars may also indicate cocoons are being formed. Damaged shoots are easily recognized in mid-summer by their short, stubby needles and generally brown, withered appearance. Mined shoots turn reddish brown, dry, and become brittle. Accumulations of frass and sparse silk webbing are usually evident.

To facilitate cup installation, remove needles below infested shoots for a distance of 15-20 cm. Measure stem diameters with calipers at about the level for installed cups, or slightly higher to allow a tight fit. Mark measured diameters in the center of cup bottoms with intersecting lines and cut holes with a single edge razor blade. Then cut slits from two opposing corners of the hole to the cup sides, forming a continuous slit across the bottom diameter of the cup. Extend one slit up one side of the cup to the rim. Take care not to slit the opposing side, otherwise the cup will break into halves. Cups can now be partially opened and placed around tree stems below infested shoots.



Figure 2.—Cocoons of *Rhyacionia neomexicana* attached to tree bole. Note shot hole below center cocoon.

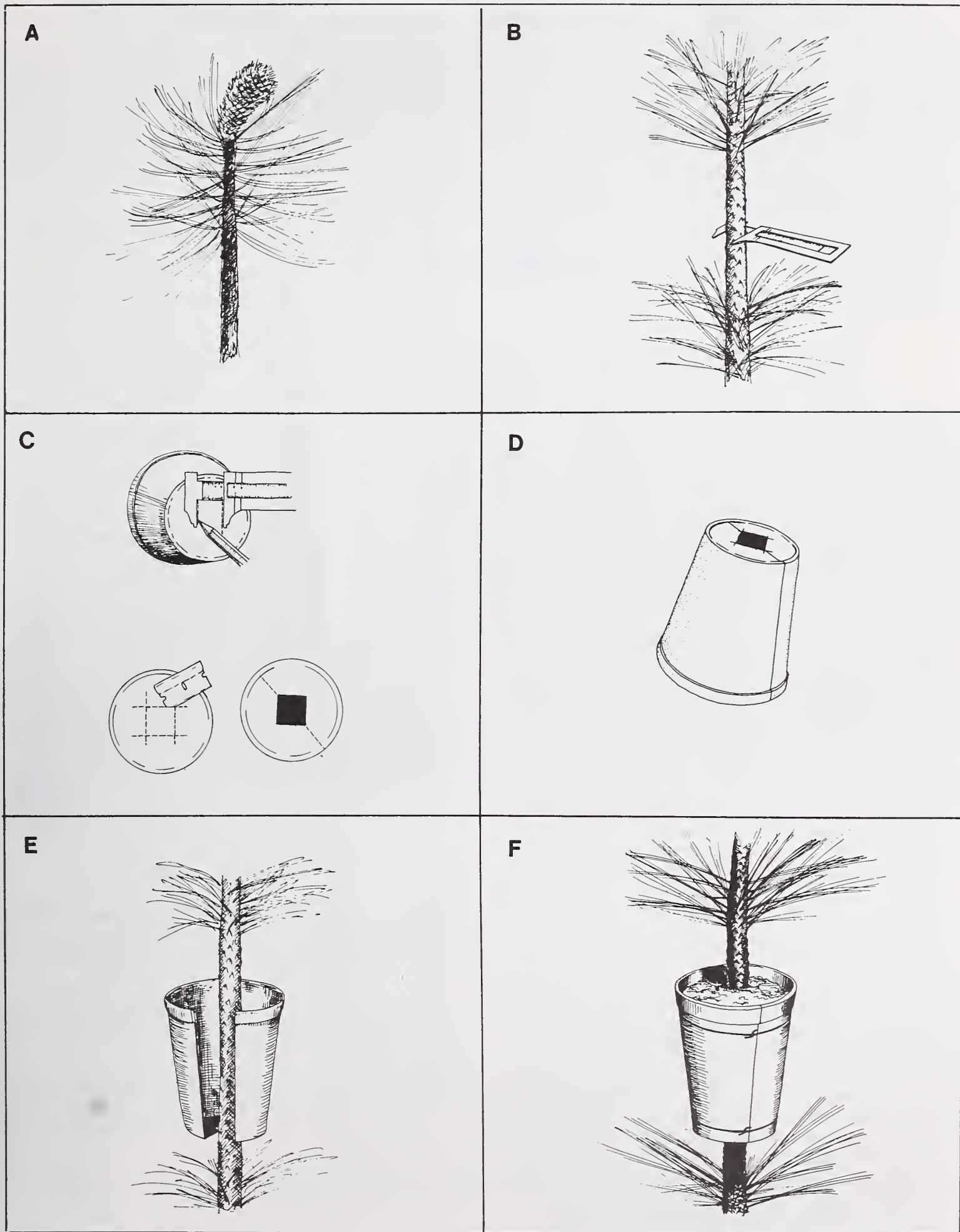


Figure 3.—Procedure for installing cups (see text).

Place two wires around the circumference of each cup, one near the bottom and one near the top. Soft, light-duty steel wire works best. Wires are twisted tight with pliers and excess ends trimmed with wire cutters. Tightening the wires closes the cup and forms a seal between the cup and tree bole.

Fill cups to about 1 cm of the top with loose sandy soil free of rocks, sticks, and other debris. Soil can be sifted prior to installation and placed in a bucket for storage and transportation. Or, dig soil near bases of infested trees and place directly into the cups. Hand trowels are excellent for digging soil and filling cups. Use waterproof markers to permanently number and mark cups for data reference.

Collection and Rearing

Leave cups in the field until all larvae have left the shoots, usually by early August for *R. neomexicana*. Two methods have been used for collecting pupae from cups. The easiest and least destructive method is to cut fastening wires and remove the cup and soil from the tree bole. The cocoons usually remain attached to the tree and can be removed gently with forceps. Occasionally, some pupae detach and are found in the ring of soil that was nearest the tree. Place collected pupae in vials or cartons for rearing.

A more destructive method, but one that simulates natural conditions by leaving cocoons attached, is to cut the tree stem above and below the cup and remove the cup intact. Place masking tape over the hole in the cup bottom to retain soil and tree stem. Transport cups, upright, to the laboratory and disassemble or place in an insectary for rearing pupal parasitoids and adult moths. To retain emerging insects, place fine nylon mesh screening over the cup tops and secure with rubber bands.

Parasitoids of *R. neomexicana* pupae collected at Chevelon were reared in the laboratory from these pupation cups. In the field, cups were placed beneath infested shoots in early July, retrieved after pupation had ceased in late July and early August, and held at room temperature (about 20° C) in the laboratory until September or October. Cups were inspected daily (5 days per week) and emerging parasitoids collected and preserved in 70% ethanol. For rearing spring-emerging parasitoids and adult tip moths, cups were stored in a walk-in cooler (4-5° C) from September/October to February/March, when they were again held at room temperature. Emerging parasitoids were processed as before; adult moths were killed and pinned. In this manner, collections and rearings were made of both summer/fall and spring-emerging parasitoids of *R. neomexicana*, and of spring-emerging moths.

Discussion

The pupation cups are relatively inexpensive, easily installed, and easily disassembled or removed. Pupae are concentrated along the tree bole in an easily accessible place, apparently free of mammal predation. The necessity for digging around root collars is eliminated; hence, pupae are less likely to be damaged.

In studies at Chevelon, elk and deer occasionally nibbled cups or tore them from trees. This problem can possibly be eliminated by painting cups a dark color; however, damage was encountered too infrequently to warrant the extra time and expense of painting. In windswept areas some soil may be dumped from cups and, in extreme cases, cups may be completely emptied. Sand is more apt to be windblown than a mixture of sand, loam, and clay. Coarse-textured soils should be used for filling cups if available; however, remove rocks and debris.

The pupation cups described in this paper were used to collect and rear pupae of *R. neomexicana* and *R. jenningsi* in Arizona. They may also be useful for collecting pupae of *R. adana* Heinrich, *R. zozana* (Kearfott), and perhaps *R. bushnelli* (Busck). *R. adana* pupates on the root collars of red pine, *Pinus resinosa* Ait.; jack pine, *P. banksiana* Lamb.; and Scots pine, *P. sylvestris* L. (Martin 1960). Stevens (1966) reported that *R. zozana* pupates around the bases of ponderosa pine, *P. ponderosa* Laws., at ground level. Apparently *R. bushnelli* "drops" from infested tips of various pines and pupates at or just below ground level (Swenk 1927). Similar cups may be useful for investigating the pupation habits of other soil-pupating insects.

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